

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

KAZUHIRO TANAKA

Application No. Unknown

Filed: October 1, 2001

For: METHOD OF AND APPARATUS FOR
CHEMICAL MECHANICAL
POLISHING, AND SLURRY
SUPPLYING DEVICE

Art Unit: Unknown

Examiner: Unknown

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the examination of the above-identified patent application, please enter the following amendments and consider the following remarks.

IN THE SPECIFICATION:

Replace the paragraph beginning at page 1, line 11 with:

Flattening a film is an absolutely necessary technique in the process of fabrication of a semiconductor device. In such a situation, there has been often used a chemical mechanical polishing apparatus. In the chemical mechanical polishing apparatus, the surface of an object to be polished such as a wafer is polished by the use of a chemical polishing material containing therein polishing particles, referred to as a slurry. In the chemical mechanical polishing apparatus of this type, in order to prevent any adverse influence by a by-product generated during polishing or a change in chemical composition of the slurry per se, the slurry is continuously supplied during the polishing.

Replace the paragraph beginning at page 1, line 24 with:

The polishing particles contained in the slurry are present in a polishing liquid as the polishing material, and they are not always dispersed in the polishing liquid in a uniform manner. Consequently, it is difficult to maintain the distribution of the polishing particles or

the size distribution of the polishing particles in a constant state all the time. If the distribution of the polishing particles or the size distribution of the polishing particles is different, a change in polishing speed with respect to the object to be polished becomes marked. As a result, the difference in distribution of the polishing particles or size distribution of the polishing particles may considerably influence machining quality such as the uniformity or flatness of polishing. In particular, as shown in Fig. 10A and Fig. 10B, the size distribution of the polishing particles or the mixing ratio of the polishing particles to the polishing liquid is usually dependent on slurry manufacturers. Therefore, the change of a manufacturer markedly influences the quality of machining. Moreover, even in the case of one and the same manufacturer, the distribution of the polishing particles or the size distribution of the polishing particles frequently varies depending on a fabrication lot. Furthermore, even in the case of one and the same fabrication lot, the content of the polishing particles contained in the polishing liquid tends to become low in the former half of slurry supplying. Thereafter, although the slurry may be temporarily supplied in an appropriate mixing ratio, the content of the polishing particles contained in the polishing liquid becomes higher in the latter half of the slurry supplying and thereafter. Additionally, there have been recently proposed a variety of techniques so that the slurry, once used in polishing, is recovered for recycling, thereby making the above-described problems more complicated. In other words, the recovered slurry for recycling is recycled after the recovered slurry is mixed with a non-used fresh slurry to adjust the components of the slurry. Therefore, the difference in distribution of the polishing particles or size distribution of the polishing particles becomes greater, so that its adverse influence on the quality of machining cannot be negligible.

IN THE CLAIMS:

Replace the indicated claims with:

1. (Amended) A method of chemical mechanical polishing comprising:
supplying a slurry; and
polishing an object with particles contained in the slurry, including controlling a physical quantity, which is a determinant factor of a polishing speed of the object, based on information on the particles contained in the slurry.
3. (Amended) A method of chemical mechanical polishing comprising:
supplying a slurry; and
polishing an object with particles contained in the slurry, including controlling polishing time based on information on the particles contained in the slurry.

4. (Amended) An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;
a polishing unit which receives the first slurry from said first slurry supplying unit and the second slurry from said second slurry supplying unit and polishes an object with particles contained in the first and second slurries; and
a control unit which controls supply of slurry from said first slurry supplying unit and from said second slurry supplying unit to said polishing unit according to polishing speed of the object.

5. (Amended) An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;
a polishing unit which receives the first slurry from said first slurry supplying unit and the second slurry from said second slurry supplying unit and polishes a surface film of an object with particles contained in the first and second slurries; and
a control unit which controls supply of slurry from said first slurry supplying unit and said second slurry supplying unit to said polishing unit according to one of type and quality of the surface film of the object.

6. (Amended) An apparatus for chemical mechanical polishing comprising:
a slurry supplying unit;
a polishing unit which receives a slurry from said slurry supplying unit and polishes an object with particles contained in the slurry;
a polishing particle information acquiring unit which acquires information on the particles contained in the slurry to be supplied to said polishing unit; and
a polishing and driving controlling unit which controls a physical quantity, which is a determinant factor of a polishing speed of the object, based on the information on the particles acquired by said polishing particle information acquiring unit.

7. (Amended) The apparatus according to claim 6, wherein
said slurry supplying unit includes a first slurry supplying unit which supplies a first slurry, and a second slurry supplying unit which supplies a second slurry, and
said apparatus further comprises a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit and supplies mixed slurry to said polishing unit.

8. (Amended) The apparatus according to claim 7, further comprising a mixture ratio controlling unit which controls a ratio of the first slurry and the second slurry mixed based on the information on the particles acquired by said polishing particle information acquiring unit.

9. (Amended) An apparatus for chemical mechanical polishing comprising:
a slurry supplying unit;
a polishing unit which receives a slurry from said slurry supplying unit and polishes an object with particles contained in the slurry;
a polishing particle information acquiring unit which acquires information on the particles contained in the slurry to be supplied to said polishing unit; and
a polishing and driving controlling unit which controls polishing time based on the information on the particles acquired by said polishing particle information acquiring unit.

10. (Amended) The apparatus according to claim 9, wherein
said slurry supplying unit includes a first slurry supplying unit which supplies a first slurry, and a second slurry supplying unit which supplies a second slurry, and
said apparatus further comprises a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit and supplies mixed slurry to said polishing unit.

11. (Amended) The apparatus according to claim 10, further comprising a mixture ratio controlling unit which controls a ratio of the first slurry and the second slurry when mixing them based on the information on the particles acquired by said polishing particle information acquiring unit.

12. (Amended) An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;
a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit;
a polishing unit which receives mixed slurry from said mixture slurry supplying unit and polishes an object with particles contained in the mixed slurry;
a polishing speed detecting unit which detects a polishing speed of the object; and
a mixture ratio controlling unit which controls said first slurry supplying unit and said second slurry supplying unit to control a ratio of the first slurry and the second slurry, when

supplying them to said mixed slurry supplying unit for mixing, based on the polishing speed detected by said polishing speed detecting unit.

13. (Amended) An apparatus for chemical mechanical polishing comprising:
- a first slurry supplying unit which supplies a first slurry;
 - a second slurry supplying unit which supplies a second slurry;
 - a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit;
 - a polishing unit which receives mixed slurry from said mixture slurry supplying unit and polishes an object with particles contained in the mixed slurry;
 - a polishing particle information acquiring unit which acquires information on the particles contained in the mixed slurry to be supplied to said polishing unit; and
 - a mixture ratio controlling unit which controls said first slurry supplying unit and said second slurry supplying unit to control a ratio of the first slurry and the second slurry, when supplying them to said mixed slurry supplying unit for mixing, based on the information on the particles acquired by said polishing particle information acquiring unit.

IN THE ABSTRACT:

Replace the Abstract with:

ABSTRACT OF THE DISCLOSURE

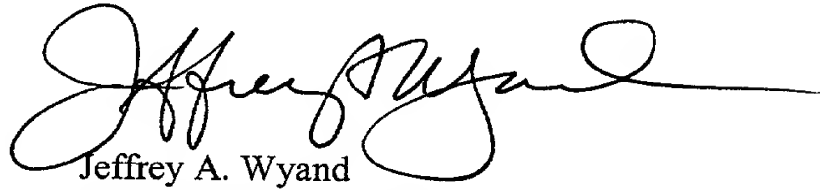
The distribution and size distribution of polishing particles contained in a slurry to be supplied to a polishing unit are measured by a measuring machine. Polishing speed with respect to a wafer is controlled to be constant by controlling a physical quantity, such as the rotation speed of a polishing surface plate, the rotation speed of a polishing head, or the pressure of the polishing head based on the measurement result.

REMARKS

The foregoing Amendment corrects translational errors and conforms the claims to United States practice. No new matter is added.

Respectfully submitted,

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KAZUHIRO TANAKA

Application No. Unknown

Art Unit: Unknown

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Examiner: Unknown

For: METHOD OF AND APPARATUS
FOR CHEMICAL MECHANICAL
POLISHING, AND SLURRY
SUPPLYING DEVICE

AMENDMENTS TO SPECIFICATION, CLAIMS AND
ABSTRACT MADE VIA PRELIMINARY AMENDMENT

Amendments to the paragraph beginning at page 1, line 11:

Flattening a film is an absolutely necessary technique in the process of fabrication of a semiconductor device. In such a situation, there has been often used a chemical mechanical polishing apparatus. In the chemical mechanical polishing apparatus, the surface of an object to be polished such as a wafer is polished by the use of a chemical polishing material containing therein polishing particles, referred to as a slurry. In the chemical mechanical polishing apparatus of this type, in order to prevent any adverse influence by a by-product generated during polishing or a change in chemical composition of the slurry per se, ~~it is general that~~ the slurry is ~~kept to be~~ continuously supplied during the polishing.

Amendments to the paragraph beginning at page 1, line 24:

The polishing particles contained in the slurry are present in a polishing liquid as the polishing material, and they are not always ~~dissolved~~ dispersed in the polishing liquid in a uniform manner. Consequently, it is difficult to maintain the distribution of the polishing particles or the size distribution of the polishing particles in a constant state all the time. If the distribution of the polishing particles or the size distribution of the polishing particles is different, a change in polishing speed with respect to the object to be polished becomes marked. As a result, the difference in distribution of the polishing particles or size distribution of the polishing particles may considerably influence ~~on a~~ machining quality such as the uniformity or flatness of polishing ~~machining~~. In particular, as shown in Fig. 10A and

Fig. 10B, the size distribution of the polishing particles or the mixing ratio of the polishing particles to the polishing liquid is usually dependent on slurry manufacturers. Therefore, the change of a manufacturer markedly influences ~~on~~ the quality of machining. Moreover, even in the case of one and the same manufacturer, the distribution of the polishing particles or the size distribution of the polishing particles ~~is frequently varied~~ varies depending on a fabrication lot. Furthermore, even in the case of one and the same fabrication lot, the content of the polishing particles contained in the polishing liquid tends to become low in the former half of slurry supplying. Thereafter, although the slurry may be temporarily supplied in an appropriate mixing ratio, the content of the polishing particles contained in the polishing liquid becomes higher in the latter half of the slurry supplying and thereafter. Additionally, there have been recently proposed a variety of techniques so that the slurry, once used in polishing, is recovered for recycling, thereby making the above-described problems more complicated. In other words, the recovered slurry for recycling is recycled after the recovered slurry is mixed with a non-used fresh slurry to adjust the components of the slurry. Therefore, the difference in distribution of the polishing particles or size distribution of the polishing particles becomes greater, so that its adverse influence on the quality of machining cannot be negligible.

Amendments to existing claims:

1. (Amended) A method of chemical mechanical polishing comprising ~~the steps of:~~
supplying a slurry; and
polishing an object with particles contained in the slurry, ~~wherein the polishing step~~
including ~~a step of~~ controlling a physical quantity, which is a determinant factor of a
polishing speed ~~with respect to~~ of the object, based on information on the particles contained
in the slurry.
3. (Amended) A method of chemical mechanical polishing comprising ~~the steps of:~~
supplying a slurry; and
polishing an object with particles contained in the slurry, ~~wherein the polishing step~~
including ~~a step of~~ controlling a polishing time based on information on the particles
contained in the slurry.
4. (Amended) An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;

a polishing unit which receives the first slurry from said first slurry supplying unit and the second slurry from said second slurry supplying unit and polishes an object with particles contained in the ~~slurry~~ first and second slurries; and

a control unit which controls supply of slurry from said first slurry supplying unit and ~~from~~ said second slurry supplying unit to said polishing unit according to ~~a~~ polishing speed ~~with respect to~~ of the object ~~to be polished~~.

5. (Amended) An apparatus for chemical mechanical polishing comprising:

a first slurry supplying unit which supplies a first slurry;

a second slurry supplying unit which supplies a second slurry;

a polishing unit which receives the first slurry from said first slurry supplying unit and the second slurry from said second slurry supplying unit and polishes a surface film of an object with particles contained in the ~~slurry~~ first and second slurries; and

a control unit which controls supply of slurry from said first slurry supplying unit and said second slurry supplying unit to said polishing unit according to ~~the~~ one of type or and quality of the surface film of the object.

6. (Amended) An apparatus for chemical mechanical polishing comprising:

a slurry supplying unit;

a polishing unit which receives ~~the~~ a slurry from said slurry supplying unit and polishes an object with particles contained in the slurry;

a polishing particle information acquiring unit which acquires information on the particles contained in the slurry to be supplied to said polishing unit; and

a polishing and driving controlling unit which controls a physical quantity, which is a determinant factor of a polishing speed ~~with respect to~~ of the object, based on the information on the particles acquired by said polishing particle information acquiring unit.

7. (Amended) The apparatus according to claim 6, wherein

said slurry supplying unit includes a first slurry supplying unit which supplies a first slurry, and a second slurry supplying unit which supplies a second slurry, and

said apparatus ~~further comprising~~ comprises a mixture mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit and supplies ~~the~~ mixed slurry to said polishing unit.

8. (Amended) The apparatus according to claim 7, further comprising a mixture ratio controlling unit which controls a ratio of ~~the quantities of~~ the first slurry and the second

slurry ~~when mixing them~~ mixed based on the information on the particles acquired by said polishing particle information acquiring unit.

9. (Amended) An apparatus for chemical mechanical polishing comprising:
a slurry supplying unit;
a polishing unit which receives ~~the~~ a slurry from said slurry supplying unit and polishes an object with particles contained in the slurry;
a polishing particle information acquiring unit which acquires information on the particles contained in the slurry to be supplied to said polishing unit; and
a polishing and driving controlling unit which controls ~~a~~ polishing time based on the information on the particles acquired by said polishing particle information acquiring unit.

10. (Amended) The apparatus according to claim 9, wherein
said slurry supplying unit includes a first slurry supplying unit which supplies a first slurry, and a second slurry supplying unit which supplies a second slurry, and
said apparatus further ~~comprising~~ comprises a ~~mixture~~ mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit and supplies ~~the~~ mixed slurry to said polishing unit.

11. (Amended) The apparatus according to claim 10, further comprising ~~a~~ mixture ratio controlling unit which controls a ratio of ~~the quantities of the~~ first slurry and the second slurry when mixing them based on the information on the particles acquired by said polishing particle information acquiring unit.

12. (Amended) An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;
a ~~mixture~~ mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit;
a polishing unit which receives ~~the mixture of slurries~~ mixed slurry from said mixture slurry supplying unit and polishes an object with particles contained ~~mixture of slurries in the~~ mixed slurry;
a polishing speed detecting unit which detects a polishing speed ~~with respect to~~ of the object; and
a mixture ratio controlling unit which controls said first slurry supplying unit and said second slurry supplying unit ~~so as to control a ratio of the quantities of the first slurry and the~~

second slurry, when supplying them to said ~~mixture~~ mixed slurry supplying unit for mixing, based on the polishing speed detected by said polishing speed detecting unit.

13. (Amended) An apparatus for chemical mechanical polishing comprising:
- a first slurry supplying unit which supplies a first slurry;
 - a second slurry supplying unit which supplies a second slurry;
 - a ~~mixture~~ mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit;
 - a polishing unit which receives ~~the mixture of slurries~~ mixed slurry from said mixture slurry supplying unit and polishes an object with particles contained ~~mixture of slurries in the~~ mixed slurry;
 - a polishing particle information acquiring unit which acquires information on the particles contained in the ~~mixture~~ mixed slurry to be supplied to said polishing unit; and
 - a mixture ratio controlling unit which controls said first slurry supplying unit and said second slurry supplying unit ~~so as to control a ratio of the quantities of the first slurry and the second slurry, when supplying them to said~~ so as to control a ratio of the quantities of the first slurry and the second slurry, when supplying them to said ~~mixture~~ mixed slurry supplying unit for mixing, based on the information on the particles acquired by said polishing particle information acquiring unit.

Amendments to the abstract:

ABSTRACT OF THE DISCLOSURE

The distribution and size distribution of polishing particles contained in a slurry to be supplied to a polishing unit are measured by a measuring machine. Polishing speed with respect to a wafer is controlled to be constant by controlling a physical quantity, such as the rotation speed of a polishing surface plate, the rotation speed of a polishing head, or the ~~pressurizing force~~ pressure of the polishing head based on the measurement result.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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KAZUHIRO TANAKA

Application No. Unknown

Filed: October 1, 2001

For: METHOD OF AND APPARATUS
FOR CHEMICAL MECHANICAL
POLISHING, AND SLURRY
SUPPLYING DEVICE

Art Unit: Unknown

Examiner: Unknown

PENDING CLAIMS AFTER ENTRY OF PRELIMINARY AMENDMENT

1. A method of chemical mechanical polishing comprising:
supplying a slurry; and
polishing an object with particles contained in the slurry, including controlling a physical quantity, which is a determinant factor of a polishing speed of the object, based on information on the particles contained in the slurry.
2. The method of chemical mechanical polishing according to claim 1, wherein a target polishing speed is set according to the type or quality of the surface film of the object to be polished, and the physical quantity is controlled such that the target polishing speed becomes constant.
3. A method of chemical mechanical polishing comprising:
supplying a slurry; and
polishing an object with particles contained in the slurry, including controlling polishing time based on information on the particles contained in the slurry.
4. An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;
a polishing unit which receives the first slurry from said first slurry supplying unit and the second slurry from said second slurry supplying unit and polishes an object with particles contained in the first and second slurries; and

a control unit which controls supply of slurry from said first slurry supplying unit and from said second slurry supplying unit to said polishing unit according to polishing speed of the object.

5. An apparatus for chemical mechanical polishing comprising:
a first slurry supplying unit which supplies a first slurry;
a second slurry supplying unit which supplies a second slurry;
a polishing unit which receives the first slurry from said first slurry supplying unit and the second slurry from said second slurry supplying unit and polishes a surface film of an object with particles contained in the first and second slurries; and
a control unit which controls supply of slurry from said first slurry supplying unit and said second slurry supplying unit to said polishing unit according to one of type and quality of the surface film of the object.

6. An apparatus for chemical mechanical polishing comprising:
a slurry supplying unit;
a polishing unit which receives a slurry from said slurry supplying unit and polishes an object with particles contained in the slurry;
a polishing particle information acquiring unit which acquires information on the particles contained in the slurry to be supplied to said polishing unit; and
a polishing and driving controlling unit which controls a physical quantity, which is a determinant factor of a polishing speed of the object, based on the information on the particles acquired by said polishing particle information acquiring unit.

7. The apparatus according to claim 6, wherein
said slurry supplying unit includes a first slurry supplying unit which supplies a first slurry, and a second slurry supplying unit which supplies a second slurry, and
said apparatus further comprises a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit and supplies mixed slurry to said polishing unit.

8. The apparatus according to claim 7, further comprising a mixture ratio controlling unit which controls a ratio of the first slurry and the second slurry mixed based on the information on the particles acquired by said polishing particle information acquiring unit.

9. An apparatus for chemical mechanical polishing comprising:
a slurry supplying unit;

a polishing unit which receives a slurry from said slurry supplying unit and polishes an object with particles contained in the slurry;

a polishing particle information acquiring unit which acquires information on the particles contained in the slurry to be supplied to said polishing unit; and

a polishing and driving controlling unit which controls polishing time based on the information on the particles acquired by said polishing particle information acquiring unit.

10. The apparatus according to claim 9, wherein

said slurry supplying unit includes a first slurry supplying unit which supplies a first slurry, and a second slurry supplying unit which supplies a second slurry, and

said apparatus further comprises a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit and supplies mixed slurry to said polishing unit.

11. The apparatus according to claim 10, further comprising a mixture ratio controlling unit which controls a ratio of the first slurry and the second slurry when mixing them based on the information on the particles acquired by said polishing particle information acquiring unit.

12. An apparatus for chemical mechanical polishing comprising:

a first slurry supplying unit which supplies a first slurry;

a second slurry supplying unit which supplies a second slurry;

a mixed slurry supplying unit which receives and mixes the first slurry supplied by said first slurry supplying unit with the second slurry supplied by said second slurry supplying unit;

a polishing unit which receives mixed slurry from said mixture slurry supplying unit and polishes an object with particles contained in the mixed slurry;

a polishing speed detecting unit which detects a polishing speed of the object; and

a mixture ratio controlling unit which controls said first slurry supplying unit and said second slurry supplying unit to control a ratio of the first slurry and the second slurry, when supplying them to said mixed slurry supplying unit for mixing, based on the polishing speed detected by said polishing speed detecting unit.

13. An apparatus for chemical mechanical polishing comprising:

a first slurry supplying unit which supplies a first slurry;

a second slurry supplying unit which supplies a second slurry;

a mixture ratio controlling unit which controls said first slurry supplying unit and said second slurry supplying unit to control a ratio of the first slurry and the second slurry, when supplying them to said mixed slurry supplying unit for mixing, based on the information on the particles acquired by said polishing particle information acquiring unit.